"Jig-saw puzzle"

Field of the Invention

This invention relates to a jig-saw puzzle.

Background of the Invention

Jig-saw puzzles are well known and have been in existence for many years. A typical traditional jig-saw puzzle comprises a piece of art work which is laminated onto a material, usually cardboard or wood, and which is then cut into a number of interlocking pieces. Depending on the number and the size of interlocking pieces and the pattern of the artwork, jig-saw puzzles can be created which range in difficulty from puzzles which would be suitable for an infant child, up to much more complicated and challenging puzzles for adults seeking a mental challenge.

There are various known ways of making jig-saw puzzles which are challenging and difficult to complete. One way is to make the pieces very small and almost identical in colour and shape. It is also common to make jigsaws having a thousand or more pieces since all else being equal, the more pieces there are to the puzzle, the longer it takes to complete. It is also known to make jigsaw pieces which are double sided which can increase the difficulty of the puzzle.

There are also ways of making jigsaw puzzles more interesting, particularly for children by for example including special pieces in the jig-saw puzzle which have particular shapes such as numbers, letters, silhouettes of animals, or the like.

One attempt to make a more interesting/challenging puzzle is shown in US 5842697 which discloses a jig-saw puzzle which when assembled, forms a sphere. One of the disadvantages of the puzzle shown in US 5842697, is that the design is limited to a spherical shape. That limits the application of the puzzle and also somewhat limits the artwork which can be applied to the puzzle. Of less significance, there is considerable wastage in the manufacture of the pieces for the puzzle and over half of the material has to be recycled.

The present invention aims to provide a jigsaw puzzle and method of making the same which is potentially more challenging than existing puzzles and which is more flexible in terms of the designs which the puzzle may carry or form.

Any discussion of documents, acts, materials, devices, articles or the like which has been included in the present specification is solely for the purpose of providing a context for the present invention. It is not to be taken as an admission that any or all of these matters form part of the prior art base or were common general knowledge in the

field relevant to the present invention as it existed before the priority date of each claim of this application.

Summary of the Invention

In a first broad aspect, the present invention provides a jig-saw puzzle including a plurality of rigid planar pieces, a plurality of interlocking cooperative pairs of coupling elements being formed in said pieces to interlock edge to edge each adjacent piece to another adjacent piece characterised by at least some of the pieces being transition pieces which include hinges and define transitions between two intersecting surfaces in the completed puzzle.

In another broad aspect, the present invention provides a jig-saw puzzle which when completed, forms a 3-dimensional object defining at least two intersecting surfaces, the puzzle being formed from a plurality of interlocking generally planar pieces, at least some of which are transition pieces being hinged such that part of the piece is co-planar with one of the intersecting surfaces and the other pieces co-planar with a second intersecting surface.

Thus, the present invention provides that a jig-saw puzzle can be used to make a 3-dimensional object that includes edges or surfaces defining two or more intersecting surfaces. Some of the pieces, the transition pieces "wrap around" the edges of the object. Thus, a cube can now be turned into a jig-saw puzzle and yet formed from planar pieces which generally maintain the identify and familiarity of the pieces of a jig-saw puzzle.

Whilst 3-dimensional jigsaw puzzles embodying the present invention may be sold simply as a puzzle, it is also possible to market such puzzles as promotional material, for example a jigsaw in the form of a cube, with each side showing an image of Australia.

Typically, the transition pieces will define fold lines scored into one side of the pieces so that the piece may be bent in one direction only.

Typically, the angle defined between the intersecting surfaces of the transition piece in the 3-dimensional object will be substantially less than 180° depending on the object and will commonly be around 90°.

In a further related aspect of the present invention, there is provided a generally planar jig-saw puzzle piece comprising two generally planar portions joined by a hinge line, each portion defining male or female coupling means for interlocking with corresponding coupling means on adjacent pieces.

In a yet further aspect, the invention provides a method of making a jigsaw puzzle of a 3-dimensional object comprising the steps of:-

a) mapping the surfaces of the object to two dimensions

b) defining a series of transition pieces crossing edges of the object where the surfaces of the object intersect and redistributing areas of the surfaces to take account of the transition pieces;

c) separating the pieces in the two dimensional map;

d) forming hinge lines in the transition pieces; and

e) cutting out the pieces.

The cutting out of the pieces is most preferably carried out using a laser cutter, however, a knife or other cutting means may be used.

Brief Description of the Drawings

Specific embodiments of the present invention will now be described by way of example only, and with reference to the accompanying drawings in which:

Figure 1 is a schematic diagram of a transition piece for a jig-saw puzzle in a configuration which two planar elements of the transition piece are generally co-planar;

Figure 2 is a schematic diagram of a transition piece in which the two planar elements of the piece are folded to define an angle of approximately 90° ;

Figure 3 is a schematic diagram illustrating the use of transitions pieces where three intersecting planes of a 3-dimensional object meet;

Figure 4a is a plan view of a jigsaw piece which is to form a curved piece;

Figure 4b shows a section through the piece shown in Figure 4a;

Figure 4c shows a section through the piece after it has been curved;

Figure 4d shows the curved piece of Figure 4c;

Figure 5 illustrates a 3-dimensional cube which has been flattened and has had a pattern of cuts and hinges marked onto it to define jigsaw pieces as a first stage in the design of a jigsaw puzzle;

Figure 6 illustrates the introduction of spacing between the pieces shown in Figure 5 so that they can be cut separately, and the slight enlargement of each piece;

Figure 7 shows a pattern of knife cuts which to be superposed over Figure 6 which cuts are used to form hinges on transition pieces and a trapdoor piece of the puzzle;

Figure 8 shows an assembled jigsaw in the shape of a cube;

Figures 9a to 9d illustrate pieces for use where a convex curved surface meets a flat plane; and

Figures 10a and 10b illustrates an internal structural double piece defining a groove.

Detailed Description of a Preferred Embodiments

Referring to the drawings, Figure 1 shows a schematic diagram of the reverse face of a transition piece 12 which forms part of a 3 dimensional puzzle embodying the present invention. The piece is made from paperboard or cardboard to which an image has been laminated to the opposite side to that shown. The perimeter of the piece has been laser cut from a sheet of cardboard as part of a process which will be described in more detail below. The perimeter of the piece defines a series of male elements 14 and female elements 16 of interlocking means or clasps which are used to couple or lock the pieces to other pieces of the puzzle. This means of interlocking is well known to anyone familiar with the art of jigsaws and will therefore not be described in great detail. However, it is important to note that whereas in the prior art typically the female coupling element will be larger than the male coupling element which interlocks into the female coupling element, in the present invention, the interlocking means are most preferably laser cut rather than cut with a knife and that the male and female elements are substantially the same size. The pieces may be cut using a knife, however, since the pieces are cut individually, using a knife is much more expensive in terms of initial set up capital costs.

As shown, the transition piece is divided into two planar elements 18, 20 by a hinge or fold line 22 formed by partially cutting through the reverse face of the paperboard with a knife. Alternatively, the hinge line may be creased or impressed.

Figure 2 shows the transition piece, folded over along the fold line 22. The angle α between the planes in which the planar elements 18 and 20 lie is approximately 90°.

Figure 3 illustrates how three such transition pieces 12 and one standard planar jigsaw piece 30 would be used to form the corner of a cube most of the sides of the pieces 12, 30 such as sides 12a and 30a will define interlocking means. However two sides 12b of one of the transition pieces and two sides of piece 30b will simply define straight edges which abut in the assembled cube.

Figures 4a to 4d illustrate the formation of a curved jigsaw piece 40 for forming part of a curved surface such as a cylinder. A series of spaced parallel grooves are cut or grooved into cardboard as shown in cross section in Figure 4b. Once this is done the piece is cut out although the process could be reversed. The piece 40 can then be curved in one direction only as illustrated in Figure 4c and Figure 4d. To make a

convex curved piece the grooves are cut in the reverse (non-picture) side of the piece. For a concave piece the grooves are cut in the outwardly facing (picture) face of the piece.

Figures 5 to 7 illustrate the steps involved in the production of a 3-dimensional puzzle in the shape of a cube. A 3-dimensional jigsaw has to have the object surfaces mapped and reduced to two dimensions for producing on flat cardboard. Also during the mapping process, the placement of the transition pieces for edges and corners has to be accommodated.

With a simple 2-dimensional jigsaw, a laminated cardboard picture is used and placed under a standard die cutting press and cut into pieces. In this process, due to the thickness of the blade, a small amount of cardboard will be removed between the pieces, including a small amount of cardboard removed from between the male and female elements of the connectors. Since the pieces of a 2-dimensional jigsaw puzzle only have to slot together, the removal of the cardboard between the male and female connector elements during the manufacturing process is of no consequence.

However, in the case of a 3-dimensional jigsaw puzzle, the pieces must structurally contribute to a load bearing surface. Thus, frictional resistance between the pieces of the jigsaw is paramount to the puzzle's structural integrity. In order to gain enough friction to maintain the sides of the object, the pieces have to be a tighter fit. In the present invention, in order to gain the required friction between the pieces, the pieces are cut separately.

Figures 5 to 7 illustrate a method of making a 3-dimensional jigsaw in the form of a cube. A six sided cube may be folded flat easily. However, simply because the pieces fold together to make edges of the cube, does not automatically mean that the planes of the cube will join together. In a 2-dimensional jigsaw puzzle, the jigsaw puzzle pieces extend to and include edge pieces which form the border of the 2-dimensional puzzle. In contrast with 3-dimensional jigsaw puzzles, there is no edge of a single plane as such, instead two planes intersect and it follows that where there is an edge of one plane there will be another side or surface of the object touching that edge/plane.

Figure 5 illustrates a map of pieces for forming a cube. The dashed lines illustrate hinges 20. The continuous lines show where there will be through cuts and defines edges of pieces. A cube has six faces and twelve edges and double pieces 12 (twenty four in all) shown in Figure 5 will fold over each of the twelve edges to make sure that all planes are joined together. In the step of reducing a 3-dimensional cube to flat 2-dimensional pieces, the location of the double pieces has to be factored into the

2-dimensional map. Since the double pieces are effectively two bordering pieces joined on fold line, this means that some of the surface area from some cube faces will have to be substracted and added to others. In other words, the pre-production process of 2-dimensional mapping to a 3-dimensional object, means that there is a redistribution of surface area to accommodate the fact that the double pieces effectively wrap around the edges of an object.

In Figure 5 the 3-dimensional cube is flattened and surface area redistributed for the transition pieces. Once this step has taken place, the next step is to space the pieces apart so that they may be cut separately. Figure 6 shows this step with each piece having been enlarged by 0.01mm to allow for loss of material during subsequent laser cutting of the pieces. The hinged lines cannot be laser cut but must be formed by a knife and the pattern of knife cuts 60 to be superposed on the pieces to form the hinges of the intersecting pieces as shown in Figure 7. Note also in Figure 6, the presence of a trap door piece 48, a larger piece defining a hinged trap door 50 which facilitates the completion of the closed 3-dimensional cube. Trap door pieces are known in the context of for example US 5842697 in the formation of the sphere and allow access to the interior of the puzzle for completion of the same. After the knife cuts have been formed on the puzzle (on the reverse face to the image) the pieces are cut out, most preferably with a laser as it is preferred that the side edges of the pieces are straight and perpendicular to the faces of the pieces, rather than curved and crushed as occurs with knife cutting of traditional jigsaws, so that the pieces interlock as a substantially exact fit with high levels of resistance between the pieces.

Figure 8 shows an assembled cube 32 made from a jigsaw embodying the present invention.

Figures 9 to 12 illustrate additional pieces which may be used in making 3-D objects other than a cube.

In particular, Figures 9a, b and c illustrate the pieces for use where a curved surface, such as a side of a cylinder meet a planar surface such as the edge of a cylinder. The curved piece 40 is made using the same principal as the piece shown in Figures 4a to 4c. The curved piece and the mating flat piece 42 which defines a curved edge with the same degree of curvature as the curved piece 40 both define a male 43 and female connector 44 on their mating edges 45, 46. Other edges also define connectors however these are omitted for the sake of clarity. The neck of the male connector is relatively wide as shown in Figure 9b to give more cross-sectional area and defines a score line 48 so that the clasp can fold through 90° to interlock the two pieces together as illustrated in Figure 9c. A convex surface meeting a flat plane is

illustrated in Figure 9. A concave surface meeting a plane can also be provided and works on the same principal as the convex surface meeting the flat plane and relies on hinged male connectors.

Figure 10 illustrates an internal structural double piece 70 which includes a hinge line 72 male connectors 14, female connectors 16 and a part 74 which is hinged to an external facing piece 73 and defines a slot 76. The slot may be used to mate with other slots or a reinforcing means such as an internal frame.

Although the above description shows transition pieces 12 bent through 90 ° it will be appreciated that angles of greater than, or less than 90 ° may be used.

Although the above described embodiment the 3-D jigsaw puzzle is formed from paperboard or cardboard, it will be appreciated that other materials may be used such as plastic, foam materials and wood. With paperboard and cardboard the minimum thickness of the material is about 1 to 2mm, with greater thickness providing greater rigidity It will also be appreciated that it would be possible to create a picture on both sides of the jigsaw puzzle rather than only one side. It would also be appreciated that the number of male and female clasps on each side for the piece may be varied from that described, more clasps being generally preferred for greater robustness and rigidity of the puzzle.

It will be appreciated by persons skilled in the art that numerous variations and/or modifications may be made to the invention as shown in the specific embodiments without departing from the spirit or scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive.